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(54) **WASHABLE RFID DEVICE FOR APPAREL TRACKING**

WASCHBARE RFID-VORRICHTUNG ZUR NACHVERFOLGUNG VON KLEIDUNGSSTÜCKEN

DISPOSITIF D'IDENTIFICATION RADIOFRÉQUENCE (RFID) LAVABLE POUR SUIVI DE VÊTEMENT

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(56) References cited:

DE-A1-102006 052 517	**DE-U1- 20 104 647**
DE-U1-202006 009 939	**US-A- 5 785 181**
US-A- 5 906 004	**US-A1- 2005 121 479**
US-A1- 2006 044 769	**US-A1- 2007 052 613**
US-A1- 2007 251 207	**US-A1- 2008 074 272**
US-A1- 2008 252 461	**US-B1- 6 378 774**
US-B1- 6 646 552	**US-B1- 6 774 865**
US-B2- 6 677 917	**US-B2- 7 486 252**

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Description

BACKGROUND

[0001] The present inventive subject matter relates generally to the art of radio frequency (RF) communications. Particular relevance is found in connection with washable or otherwise durable RFID (RF IDentification) devices that are particularly advantageous, for example, to track clothing or apparel, and accordingly the present specification makes specific reference thereto. However, it is to be appreciated that aspects of the present inventive subject matter are also equally amenable to other like applications.

[0002] RFID devices are generally known in the art. Conventionally, RFID tags, labels and/or transponders (collectively referred to herein as "devices") are widely used to associate a tagged or labeled object with an identification code or other information provided by the RFID device. In conventional parlance, an RFID label generally refers to an RFID device that is adhesively or similarly attached directly to an object, and an RFID tag, in contrast, generally refers to an RFID device that is secured to objects by other means (e.g., by a mechanical fastener such as screw, rivet, etc. or by another suitable fastener or fastening means). In any event, RFID devices are conventionally used, e.g., to track inventory, parcels and/or other objects.

[0003] A typical RFID device generally includes a number of components including an antenna for wirelessly transmitting and/or receiving RF signals and analog and/or digital electronics operatively connected thereto. So called active or semi-passive RFID devices may also include a battery or other suitable power source. Commonly, the electronics are implemented via an integrated circuit (IC) or microchip or other suitable electronic circuit and may include, e.g., communications electronics, data memory, control logic, etc. In operation, the IC or microchip functions to store and/or process information, modulate and/or demodulate RF signals, as well as optionally performing other specialized functions. In general, RFID devices can typical retain and communicate enough information to uniquely identify individuals, packages, inventory and/or other like objects, e.g., to which the RFID device is affixed.

[0004] Commonly, an RFID reader or base station is used to wirelessly obtain data or information (e.g., such as the aforementioned identification code) communicated from an RFID device. The manner in which the RFID reader interacts and/or communicates with the RFID device generally depends on the type of RFID device. A given RFID device is typically categorized as a passive device, an active device, a semi-passive device (also known as a battery-assisted or semi-active device) or a beacon type RFID device (which can be thought of as a sub-category of active devices). Passive RFID devices generally use no internal power source, and as such, they are passive devices which are only active when an RFID reader is nearby to power the RFID device, e.g., via wireless illumination of the RFID device with an RF signal and/or electromagnetic energy from the RFID reader. Conversely, semi-passive and active RFID devices are provided with their own power source (e.g., such as a small battery). To communicate, conventional RFID devices (other than so called beacon types) respond to queries or interrogations received from RFID readers. The response is typically achieved by backscattering, load modulation and/or other like techniques that are used to manipulate the RFID reader's field. Commonly, backscatter is used in far-field applications (i.e., where the distance between the RFID device and reader is greater than approximately a few wavelengths), and alternately, load modulation is used in near-field applications (i.e., where the distance between the RFID device and reader is within approximately a few wavelengths).

[0005] Passive RFID devices typically signal or communicate their respective data or information by backscattering a carrier wave from an RFID reader. That is to say, in the case of conventional passive RFID devices, in order to retrieve information therefrom, the RFID reader typically sends an excitation signal to the RFID device. The excitation signal energizes the RFID device which transmits the information stored therein back to the RFID reader. In turn, the RFID reader receives and decodes the information from the RFID device.

[0006] As mentioned earlier, passive RFID devices commonly have no internal power supply. Rather, power for operation of a passive RFID device is provided by the energy in the incoming RF signal received by the RFID device from the RFID reader. Generally, a small electrical current induced in the antenna of the RFID device by the incoming RF signal provides just enough power for the IC or microchip in the RFID device to power up and transmit a response. This means that the antenna generally has to be designed both to collect power from the incoming signal and also to transmit the outbound backscatter signal.

[0007] Passive RFID devices have the advantage of simplicity and long life (e.g., having no battery to go dead). Nevertheless, their performance may be limited. For example, passive RFID devices generally have a more limited range as compared to active RFID devices.

[0008] Active RFID devices, as opposed to passive ones, are generally provisioned with their own transmitter and a power source (e.g., a battery, photovoltaic cell, etc.). In essence, an active RFID device employs the self-powered transmitter to broadcast a signal which communicates the information stored on the IC or microchip in the RFID device. Commonly, an active RFID device will also use the power source to power the IC or microchip employed therein.

[0009] Broadly speaking, there are two kinds of active RFID devices - one can be generally thought of as a transponder type of active RFID device and the other as a beacon type of active RFID device. A significant difference is that active transponder type RFID devices are only woken up when they receive a signal from an RFID reader. The transponder type RFID device, in response to the inquiry signal from the RFID reader, then broadcasts its information to the reader. As can be appreciated, this type of active RFID device conserves battery life by having the device broadcast its signal only when it is within range of a reader. Conversely, beacon type RFID devices transmit their identification code and/or other data or information autonomously (e.g., at defined intervals or periodically or otherwise) and do not respond to a specific interrogation from a reader.

[0010] Generally, active RFID devices, due to their onboard power supply, may transmit at higher power levels (e.g., as compared to passive devices), allowing them to be more robust in various operating environments. However, the battery or other on-board power supply can tend to cause active RFID devices to be relatively larger and/or more expensive to manufacture (e.g., as compared to passive devices). Additionally, as compared to passive RFID devices, active RFID devices have a potentially more limited shelf life - i.e., due to the limited lifespan of the battery. Nevertheless, the self supported power supply commonly permits active RFID devices to include generally larger memories as compared to passive devices, and in some instances the on-board power source also allows the active device to include additional functionality, e.g., such as obtaining and/or storing environmental data from a suitable sensor.

[0011] Semi-passive RFID devices are similar to active devices in that they are typically provisioned with their own power source, but the battery commonly only powers the IC or microchip and does not provide power for signal broadcasting. Rather, like passive RFID devices, the response from the semi-passive RFID device is usually powered by means of backscattering the RF energy received from the RFID reader, i.e., the energy is reflected back to the reader as with passive devices. In a semi-passive RFID device, the battery also commonly serves as a power source for data storage.

[0012] A conventional RFID device will often operate in one of a variety of frequency ranges including, e.g., a low frequency (LF) range (i.e., from approximately 30 kHz to approximately 300 kHz), a high frequency (HF) range (i.e., from approximately 3 MHz to approximately 30 MHz) and an ultra-high frequency (UHF) range (i.e., from approximately 300 MHz to approximately 3 GHz). A passive device will commonly operate in any one of the aforementioned frequency ranges. In particular, for passive devices: LF systems commonly operate at around 124 kHz, 125 kHz or 135 kHz; HF systems commonly operate at around 13.56 MHz; and, UHF systems commonly use a band anywhere from 860 MHz to 960 MHz. Alternately, some passive device systems also use 2.45 GHz and other areas of the radio spectrum. Active RFID devices typically operate at around 455 MHz, 2.45 GHz, or 5.8 GHz. Often, semi-passive devices use a frequency around 2.4GHz.

[0013] The read range of an RFID device (i.e., the range at which the RFID reader can communicate with the RFID device) is generally determined by many factors, e.g., the type of device (i.e., active, passive, etc.). Typically, passive LF RFID devices (also referred to as LFID or LowFID devices) can usually be read from within approximately 12 inches (0.33 meters); passive HF RFID devices (also referred to as HFID or HighFID devices) can usually be read from up to approximately 3 feet (1 meter); and passive UHF RFID devices (also referred to as UHFID devices) can be typically read from approximately 10 feet (3.05 meters) or more. One important factor influencing the read range for passive RFID devices is the method used to transmit data from the device to the reader, i.e., the coupling mode between the device and the reader - which can typically be either inductive coupling or radiative/propagation coupling. Passive LFID devices and passive HFID devices commonly use inductive coupling between the device and the reader, whereas passive UHFID devices commonly use radiative or propagation coupling between the device and the reader.

[0014] In inductive coupling applications (e.g., as are conventionally used by passive LFID and HFID devices), the device and reader are typically each provisioned with a coil antenna that together form an electromagnetic field therebetween. In inductive coupling applications, the device draws power from the field, uses the power to run the circuitry on the device's IC or microchip and then changes the electric load on the device antenna. Consequently, the reader antenna senses the change or changes in the electromagnetic field and converts these changes into data that is understood by the reader or adjunct computer. Because the coil in the device antenna and the coil in the reader antenna have to form an electromagnetic field therebetween in order to complete the inductive coupling between the device and the reader, the device often has to be fairly close to the reader antenna, which therefore tends to limit the read range of these systems.

[0015] Alternately, in radiative or propagation coupling applications (e.g., as are conventionally used by passive UHFID devices), rather than forming an electromagnetic field between the respective antennas of the reader and device, the reader emits electromagnetic energy which illuminates the device. In turn, the device gathers the energy from the reader via its antenna, and the device's IC or microchip uses the gathered energy to change the load on the device antenna and reflect back an altered signal, i.e., backscatter. Commonly, UHFID devices can communicate data in a variety of different ways, e.g., they can increase the amplitude of the reflected wave sent back to the reader (i.e., amplitude shift keying), shift the reflected wave so it's out of phase received wave (i.e., phase shift keying) or change the frequency of the reflected wave (i.e., frequency shift keying). In any event, the reader picks up the backscattered signal and converts the altered wave into data that is understood by the reader or adjunct computer.

[0016] The antenna employed in an RFID device is also commonly affected by numerous factor, e.g., the intended application, the type of device (i.e., active, passive, semi-active, etc.), the desired read range, the device-to-reader coupling mode, the frequency of operation of the device, etc. For example, insomuch as passive LFID devices are normally inductively coupled with the reader, and because the voltage induced in the device antenna is proportional to the operating frequency of the device, passive LFID devices are typically provisioned with a coil antenna having many turns in order to produce enough voltage to operate the device's IC or microchip. Comparatively, a conventional HFID passive device will often be provisioned with an antenna which is a planar spiral (e.g., with 5 to 7 turns over a credit-card-sized form factor), which can usually provide read ranges on the order of tens of centimeters. Commonly, HFID antenna coils can be less costly to produce (e.g., compared to LFID antenna coils), since they can be made using techniques relatively cheaper than wire winding, e.g., lithography or the like. UHFID passive devices are usually radiatively and/or propagationally coupled with the reader antenna and consequently can often employ conventional dipole-like antennas.

[0017] Using an RFID device to track and/or inventory apparel is not unknown. However, there are problems with many conventional solutions. For example, the RFID device can be eventually destroyed or its performance severely degraded by repeated washings of the tagged clothing or other apparel item, particularly in applications where a machine laundry process is being used. For example, entertainment facilities, amusement parks, and/or other enterprises employing a plurality of costumes or uniforms or other apparel, may desire to track and/or inventory that apparel by providing selected apparel items with respective RFID devices. However, subjecting the apparel items, along with the RFID devices affixed thereto, to repeated washing and/or other laundry processes can tend to damage the RFID devices. That is to say, the heat, stress, humidity, chemical cleaners and/or other environmental conditions associated with conventional laundry processes may tend to damage (i.e., destroy or degrade the performance of) an RFID device exposed thereto.

[0018] US 2008/0074272 A1 refers to a textile information carrier consisting of a textile label or textile goods or a tag connected to the goods comprising an electric antenna and a detection wafer comprising an electronic chip module, connected to the textile label, textile goods or tag. A coupling element connected to the electric chip module is disposed on the detection wafer, said coupling element being inductively and/or capacitively coupled to the electric antenna of the textile label, the textile goods or the tag.

[0019] DE 10 2006 052 517 A1 refers to electric chip module for a RFID system, especially a RFID tag or a RFID inlay for a RFID tag. The RFID tag can be made of a web-shaped material carrying a RFID chip and an antenna which is electrically connected to the RFID chip.

[0020] Further documents representing related art are US 2006/0044769 A1, US 2007/0052631 A1, US 6,378,774 B1, US 6,774,865 B1, DE 201 04 647 U1, US 2007/0251207 A1, US 6,677,917 US 7,486,252 B2, and US 5,906,004 A.

[0021] US 6,677,917 discloses a fabric antenna for tags.

[0022] Utility model DE 20 2006 009 939 U1 discloses an RFID transponder with a hole.

[0023] From US 6,154,138 an alarm device for clothes is known.

[0024] DE 201 04 647 U1 discloses a housing for a transponder in the shape of a button and a bracket, preferably made of metal, which is used for easily opening and closing the housing.

[0025] US 6646552 B1 discloses a data carrier for contactless control of persons upon utilization of a service in skiing areas, which has a chip with an antenna and is disposed in a glove

[0026] US 2005/0121479 A1 discloses a substantially cylindrical body of button which is nailed to a circular base to form a circular placement to receive the (previously encapsulated) assembly formed by chip and antenna, with such encapsulation resulting in an opening to concentrically receive the plastic plug, and said plug projecting a lower circular flap located in a hole provided on the base of the button, configuring a small opening; finally, the locking pin is nailed to the button body.

[0027] US 5785181 discloses a permanently attached identification device which is a button sized RFID tag having a unique number to a garment.

[0028] US 2008/0252461 A1 discloses a short-range communication RFID, which is a first identification medium, incorporated in a top stop of a slide fastener, with a hole of a first pull tab in a first pull-tab member of a slider having a second pull-tab member removably attached thereto. The second pull-tab member is provided with a long-range communication RFID which is a second identification medium. The second identification medium is removably mounted on an article.

[0029] Accordingly, a new and/or improved RFID device is disclosed which addresses the above-referenced problem(s) and/or others.

SUMMARY

[0030] Claim 1 defines an RFID device according to the invention.

[0031] Preferred embodiments are defined in the dependent claims.

[0032] Numerous advantages and benefits of the inventive subject matter disclosed herein will become apparent to those of ordinary skill in the art upon reading and understanding the present specification.

BRIEF DESCRIPTION OF THE DRAWING(S)

[0033] The inventive subject matter disclosed herein may take form in various components and arrangements of components, and in various steps and arrangements of steps. The drawings are only for purposes of illustrating preferred embodiments and are not to be construed as limiting. Further, it is to be appreciated that the drawings may not be to scale.

FIGURE **1** is a diagrammatic illustration showing an exemplary RFID device in accordance with aspects of the present inventive subject matter.

FIGURE **2** is a diagrammatic illustration showing an exemplary implementation of the RFID device depicted in FIGURE **1**.

FIGURES **3A** and **3B** are diagrammatic illustrations showing alternate arrangements and/or embodiments of the RFID device depicted in FIGURE **1**.

DETAILED DESCRIPTION OF THE EMBODIMENT(S)

[0034] For clarity and simplicity, the present specification shall refer to structural and/or functional elements, relevant standards and/or protocols, and other components that are commonly known in the art without further detailed explanation as to their configuration or operation except to the extent they have been modified or altered in accordance with and/or to accommodate the preferred embodiment(s) presented herein.

[0035] In general, there is disclosed herein a washable or otherwise durable RFID device that can withstand repeated exposure to washing and/or other laundry processes, and therefore the RFID device is well suited to apparel tracking and/or inventorying. In one suitable embodiment, the aforementioned RFID device is a passive UHFID device employing an RFID IC or microchip that is operatively connected to a relatively small UHF inductive loop antenna. For example, the loop antenna optionally has a diameter of approximately 12 mm.

[0036] Suitably, the IC or microchip and the operatively connected loop antenna are encapsulated in a significantly durable and/or substantially rigid material or encapsulant, e.g., such as plastic. In practice, the encapsulant is optionally durable enough to protect the IC or microchip and operatively connected loop antenna from experiencing any significant damage or performance degradation as a result of repeated expose to washing and/or other laundry processes. Optionally, the IC or microchip and operatively connected loop antenna along with the encapsulant surrounding the same form an otherwise standard clothing button. For example, holes or the like are optionally drilled or otherwise formed in the encapsulant so that the combined structure (referred to herein nominal as the "button structure") may be readily sewn or otherwise affixed to a garment or other apparel item.

[0037] As can be appreciated, the button structure alone is generally not readable at relatively large distances with a conventional RFID reader. For example, the typical read range of the button structure described herein (i.e., a passive UHFID device including an RFID IC or microchip operatively connected to a UHF inductive loop antenna with an approximate 12 mm diameter, both encapsulated in plastic) is generally no more than about 15.24 cm. Therefore, in one suitable embodiment, the button structure is affixed or sewn to the garment or other apparel item near another larger radiating structure to "amplify" the RFID signal(s) exchanged with an associated RFID reader. That is to say, the read range of the overall RFID device (i.e., the button structure along with the radiating structure) is increased as a result of inductive coupling between the button structure's loop antenna and the radiating structure. For example, read ranges of approximately 6 meters or greater can be achieved.

[0038] In practice, the radiating structure can be made from any of a variety of electrically conductive materials and/or components having a wide variety of lengths, sizes, shapes, patterns, etc. In any event, the radiating structure is optionally sufficiently durable to withstand repeated washing and/or other laundry processes without experiencing significant damage and/or performance degradation. Optionally, the radiating structure is made from an electrically conductive thread (e.g., a standard type sewing thread coated and/or embedded with a metal or other conductive material), thin wire or the like that is sewn in a selected pattern directly within the garment or other apparel item near the location where the button structure is to be affixed or otherwise attached to the garment or apparel item. Alternately, the radiating structure can be similarly provisioned in or on a patch or label or the like which is in turn ironed-on or sewed or otherwise secured or attached at the proper location to the garment or apparel item that is receiving the RFID device. In either case, the radiating structure is optionally encapsulated in a suitable material to further enhance its protection from washing and/or other laundry processes. That is to say, the electrically conductive thread, wire or other like component is optionally coated or otherwise encased in a suitable protective layer and/or material.

[0039] With reference now to FIGURE **1**, there is shown an exemplary RFID device **10** in accordance with aspects of the present inventive subject matter. Optionally, the device **10** is a passive UHFID device. As shown, the device **10** includes an RFID IC or microchip **12** that is operatively connected to a relatively small UHF inductive loop antenna **14**. For example, the loop antenna optionally has a diameter of approximately 12 mm. Suitably, the IC or microchip **12** includes selected electronics commonly found in any conventional RFID IC or microchip and/or operates in a manner similar to any conventional RFID IC or microchip. For example, the IC or microchip **12** optionally includes communications electronics, data memory, control logic, etc. In operation, the IC or microchip **12** optionally functions to store and/or process information (e.g., such as a unique identification code), modulate and/or demodulate RF signals, as well as optionally performing other conventional RFID functions. In general, the RFID device **10** suitably retains and communicates enough information to uniquely identify a garment, apparel item or other like object on which the device **10** is provided.

[0040] In one suitable embodiment, the IC or microchip **12** is bonded and electrically connected directly to the antenna **14** without any intermediate connecting leads. Alternately, an intermediate connection lead (not shown) is used instead of bonding the IC or microchip **12** directly to the antenna **14**. For example, the intermediate leads can facilitate the process of operatively connecting the IC or microchip **12** to the antenna **14**, which can be particularly difficult with smaller ICs or microchips. Thus, to interconnect the relatively small IC or microchip **12** to the antennas **14** in RFID device **10**, intermediate structures variously referred to as "strap leads," "interposers," and "carriers" are sometimes used to facilitate the manufacture of the device **10**. Suitably, the intermediate structures include conductive leads or pads that are electrically coupled to the contact pads of the IC or microchip **12** for coupling the IC or microchip **12** to the antenna **14**. These leads provide a larger effective electrical contact area between the IC or microchip **12** and the antenna **14** than do the contact pads of the IC or microchip **12** alone. Additionally, with the use of the intermediate structures in the manufacturing process, the alignment between the antenna **14** and the IC or microchip **12** does not have to be as precise during the placement of the IC or microchip **12** on the antenna **14**, e.g., as compared to when such strap leads are not used in the manufacturing process.

[0041] In the illustrated embodiment, the IC or microchip **12** and the operatively connected loop antenna **14** are encapsulated in an encapsulant **16** made from a significantly durable and/or substantially rigid material. For example, the encapsulant **16** is optionally made of a sufficiently durable and/or rigid plastic material. In practice, the encapsulant **16** is optionally durable enough to protect the IC or microchip **12** and operatively connected loop antenna **14** from experiencing any significant damage or performance degradation as a result of repeated expose to washing and/or other laundry processes. The combination of the IC or microchip **12** and operatively connected loop antenna **14** along with the encapsulant **16** surrounding the same are collectively referred to herein nominally as the "button structure" **18** since they optionally form what appears to be and/or function as an otherwise standard clothing button. As is shown in the illustrated embodiment, one or more holes **20** or the like are optionally drilled or otherwise formed in the encapsulant **16** so that the button structure **18** may be readily sewn or otherwise affixed to a garment or other apparel item (e.g., as better seen in FIGURE **2**).

[0042] Returning attention now to FIGURE **1**, the RFID device **10** also includes a radiating structure **22** that is in practice located sufficiently near and/or arranged with respect to the button structure **18** so as to inductively couple with the loop antenna **14** thereby substantially extending the effective distance (i.e., read range) at which the device **10** can be read by an associated RFID reader (not shown). Suitably, the radiating structure **22** is made from any of a variety of electrically conductive materials and/or components having a wide variety of lengths, sizes, shapes, patterns, etc. In any event, the radiating structure **22** is optionally sufficiently durable to withstand repeated washing and/or other laundry processes without experience significant damage and/or performance degradation. Optionally, the radiating structure **22** is made from an electrically conductive thread (e.g., a standard type sewing thread coated and/or embedded with a metal or other conductive material), thin wire or the like. In one suitable embodiment, the radiating structure **22** is sewn in a selected pattern directly in the garment or other apparel item near the location where the button structure **18** is to be affixed or otherwise attached to the garment or apparel item. In an alternate embodiment, the radiating structure **22** is similarly provisioned in or on a patch or label or the like which is in turn ironed-on or sewed or otherwise secured or attached at the proper location to the garment or apparel item that is receiving the RFID device **10**. In either case, the radiating structure **22** is encapsulated in a suitable material to further enhance its protection from washing and/or other laundry processes. For example, the electrically conductive thread, wire or other like component is optionally coated or otherwise encased in a suitable protective layer and/or material. Suitably, the radiating structure **22** increases the read range of the overall RFID device **10** (e.g., as compared to the button structure **18** alone) due to inductive coupling between the loop antenna **14** and the radiating structure **22**. For example, read ranges up to approximately 6 m or greater are optionally achieved.

[0043] Turning attention now to FIGURE **2**, there is shown a garment or apparel item **30**, e.g., such as a costume, uniform, etc., that is fitted or otherwise provisioned with an RFID device **10**. In the illustrated embodiment, the button structure **18** and radiating structure **22** are sewn or otherwise affixed to the garment **30** in sufficient proximity and/or relative arrangement to one another so as to achieve the desired inductive coupling between the loop antenna **14** and the radiating structure **22**. While highlighted for purposes of illustration in FIGURE **2**, suitably, the RFID device **10** is relatively inconspicuous by casual observation of the garment or apparel item **30**. That is to say, for example, the button structure **18** optionally has an appearance significantly similar to any other button **32** on the garment **30** and/or the radiating structure **22** is optionally selected to blend into or otherwise significantly match the threads and/or material from which the garment **30** is made.

[0044] For simplicity and/or clarity herein FIGURE **2** illustrates only one apparel item 30 provisioned with an RFID device **10**. However, it is to be appreciated that in practice an enterprise desiring to track and/or inventory its collection or stock of garments (e.g., an amusement park tracking its costumes or another facility tracking its uniforms) will generally deploy a plurality of RFID devices (such as the device **10**) affixed to a plurality of apparel items (such as the garment **30**). As can be appreciated, each RFID device **10** is suitably programmed or otherwise provisioned with a unique identification code that is communicated to an RFID reader when the device **10** is queried, read or otherwise. Accordingly, each garment or apparel item **30** can be tracked and/or inventoried by the associated identification code obtained from the attached RFID device **10**.

[0045] With reference now to FIGURES **3A** and **3B**, there are shown alternate arrangements and/or embodiments of the RFID device **10**. In particular, it is to be noted that the radiating structure **22** (e.g., as shown in FIGURES **3A** and **3B**) can optionally take a variety of different forms, shapes, patterns, lengths, etc. Additionally, the loop antenna **14** is not limited to being simply circular. Rather, the loop antenna **14** may also take a variety of different forms, shapes, patterns, lengths, etc. For example, as shown in FIGURE **3A**, the loop antenna **14** optionally takes on a somewhat rectangular shape.

Claims

1. An RFID device (10) suitable for being used with an apparel item (30), comprising:

an antenna (14);
an integrated circuit (12) coupled to the antenna (14); and
a radiating structure (22) made of a conductive material;

wherein:

the antenna (14) and the integrated circuit (12) are encapsulated with an encapsulant (16);
at least one hole (20) is formed in the encapsulant (16), wherein the integrated circuit (12), the antenna (14) and the encapsulant (16) form a structure that is suitable for being affixed to an item of apparel (30) using the at least one hole (20) formed in the encapsulant (16);
the radiating structure (22) is positioned adjacent the structure and provides a radiating antenna for the structure, the radiating structure (22) being inductively coupled with the antenna (14); and
characterized in that
the radiating structure (22) is coated in a protective material and provisioned in a patch suitable to be secured to the item of apparel (30).

2. The RFID device (10) of claim 1, wherein the encapsulant (16) is plastic.

3. The RFID device (10) of claim 1 or 2, wherein the structure formed by the integrated circuit (12), the antenna (14) and the encapsulant (16) is a button structure (18).

4. The RFID device (10) of claim 1, wherein the antenna (14) is a loop antenna.

Patentansprüche

1. RFID-Vorrichtung (10), die geeignet ist, um mit einem Kleidungsgegenstand (30) verwendet zu werden, die umfasst:

eine Antenne (14);
eine integrierte Schaltung (12), die mit der Antenne (14) gekoppelt ist; und
eine Strahlungsstruktur (22), die aus einem leifähigen Material hergestellt ist;

wobei:

die Antenne (14) und die integrierte Schaltung (12) mit einer Verkapselung (16) verkapselt sind;
wenigstens ein Loch (20) in der Verkapselung (16) ausgebildet ist, wobei die integrierte Schaltung (12), die Antenne (14) und die Verkapselung (16) eine Struktur bilden, die geeignet ist, um unter Verwendung des wenigstens einen Lochs (20), der in der Verkapselung (16) ausgebildet ist, an einem Kleidungsgegenstand (30) befestigt zu werden;
die Strahlungsstruktur (22) benachbart zu der Struktur positioniert ist und eine Strahlungsantenne für die Struktur (22) bereitstellt, die induktiv mit der Antenne (14) gekoppelt ist; und
dadurch gekennzeichnet, dass
die Strahlungsstruktur (22) mit einem Schutzmaterial überzogen ist und in einem Flicken bereitgestellt ist, der geeignet ist, um an dem Kleidungsgegenstand (30) befestigt zu werden.

2. RFID-Vorrichtung (10) nach Anspruch 1, wobei die Verkapselung (16) Kunststoff ist.

3. RFID-Vorrichtung (10) nach Anspruch 1 oder 2, wobei die Struktur, die durch die integrierte Schaltung (12), die Antenne (14) und die Verkapselung (16) ausgebildet wird, eine Knopfstruktur (18) ist.

4. RFID-Vorrichtung (10) nach Anspruch 1, wobei die Antenne (14) eine Rahmenantenne ist.

Revendications

1. Dispositif RFID (10) adapté pour être utilisé avec un article de vêtement (30), comportant :

une antenne (14) ;
un circuit intégré (12) accouplé à l'antenne (14) ; et
une structure rayonnante (22) constituée d'un matériau conducteur ;

dans lequel :

l'antenne (14) et le circuit intégré (12) sont encapsulés avec un agent d'encapsulation (16) ;
au moins un orifice (20) est formé dans l'agent d'encapsulation (16), dans lequel le circuit intégré (12), l'antenne (14) et l'agent d'encapsulation (16) forment une structure adaptée pour être fixée à un article de vêtement (30) à l'aide du au moins un orifice (20) formé dans l'agent d'encapsulation (16) ;
la structure rayonnante (22) est positionnée adjacente à la structure et fournit une antenne rayonnante pour la structure, la structure rayonnante (22) étant accouplée de façon inductive à l'antenne (14) ; et
caractérisé en ce que
la structure rayonnante (22) est revêtue d'un matériau protecteur et prévue dans un tampon adapté pour être attaché sur l'article de vêtement (30).

2. Dispositif RFID (10) selon la revendication 1, dans lequel l'agent d'encapsulation (16) est du plastique.

3. Dispositif RFID (10) selon la revendication 1 ou 2, dans lequel la structure formée par le circuit intégré (12), l'antenne (14) et l'agent d'encapsulation (16) est une structure de bouton (18).

4. Dispositif RFID (10) selon la revendication 1, dans lequel l'antenne (14) est une antenne cadre.

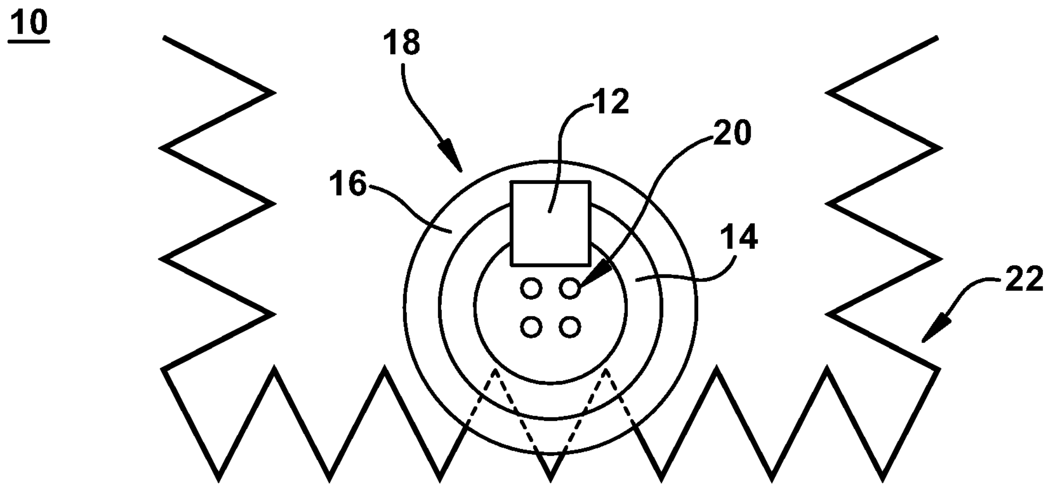

Fig. 1

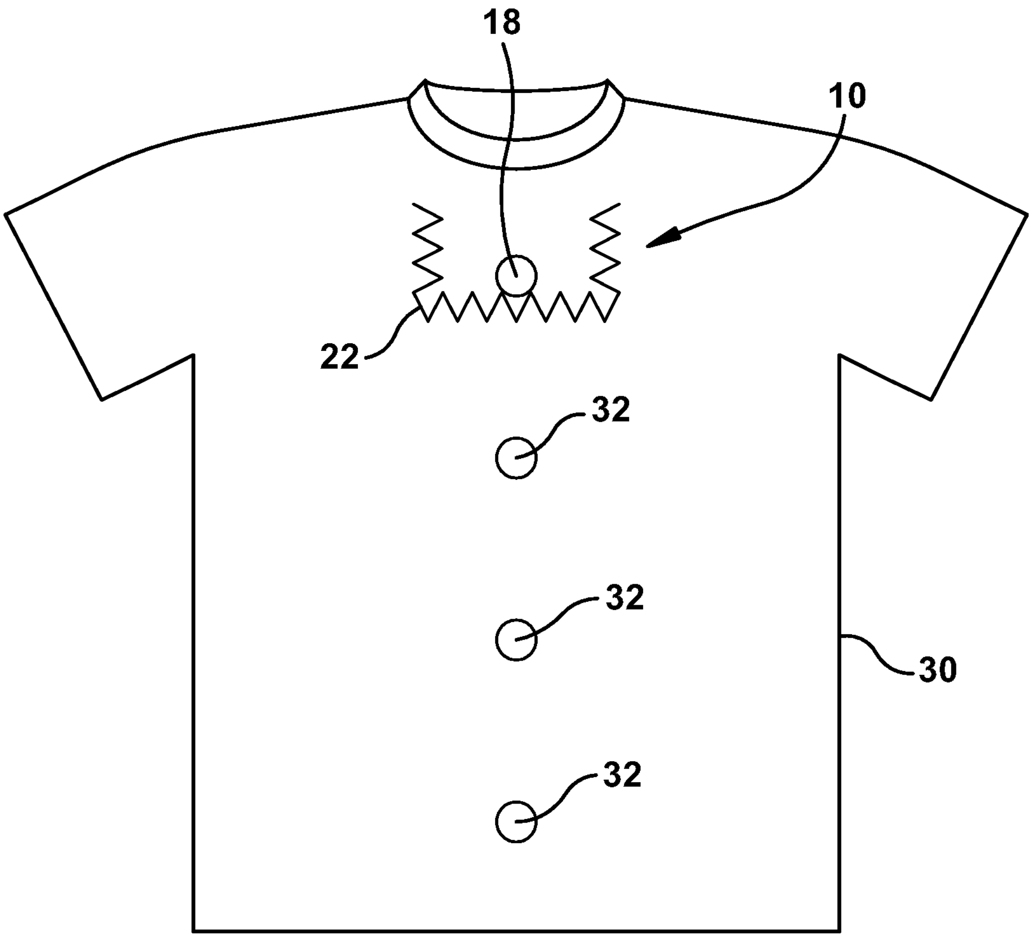

Fig. 2

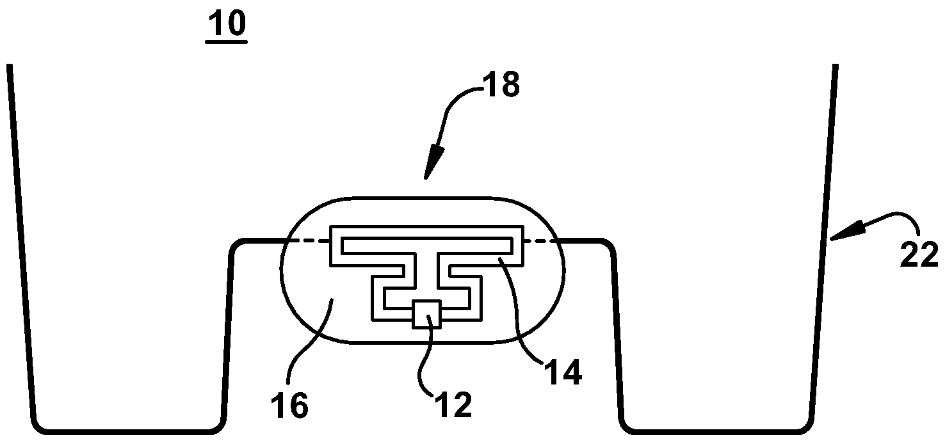

Fig. 3A

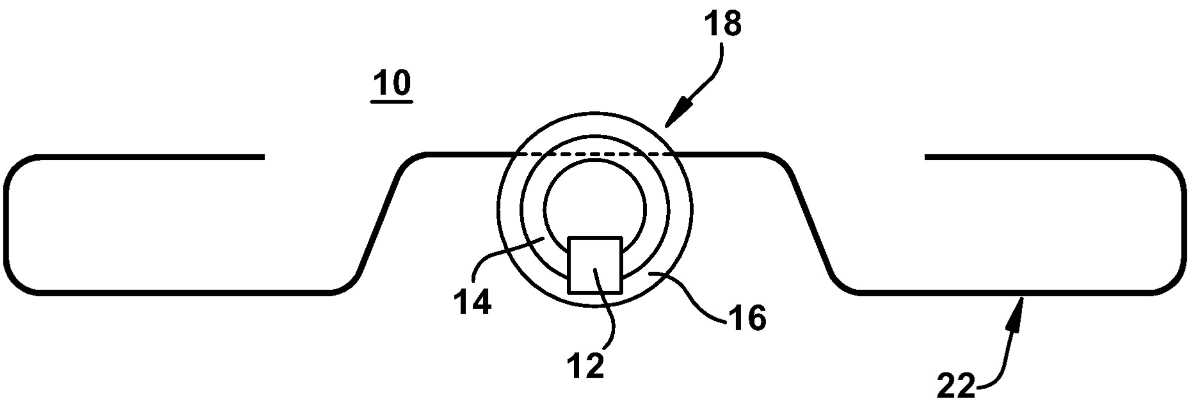

Fig. 3B

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20080074272 A1 **[0018]**
- DE 102006052517 A1 **[0019]**
- US 20060044769 A1 **[0020]**
- US 20070052631 A1 **[0020]**
- US 6378774 B1 **[0020]**
- US 6774865 B1 **[0020]**
- DE 20104647 U1 **[0020] [0024]**
- US 20070251207 A1 **[0020]**
- US 6677917 B **[0020] [0021]**
- US 7486252 B2 **[0020]**
- US 5906004 A **[0020]**
- DE 202006009939 U1 **[0022]**
- US 6154138 A **[0023]**
- US 6646552 B1 **[0025]**
- US 20050121479 A1 **[0026]**
- US 5785181 A **[0027]**
- US 20080252461 A1 **[0028]**